



IEEE SW Test Workshop

Semiconductor Wafer Test Workshop

June 7-10, 2009
San Diego, CA

Improving Scrub Performance and Reducing
Soak Time with a New Mechanism to
Stabilize Probe Card Temperature



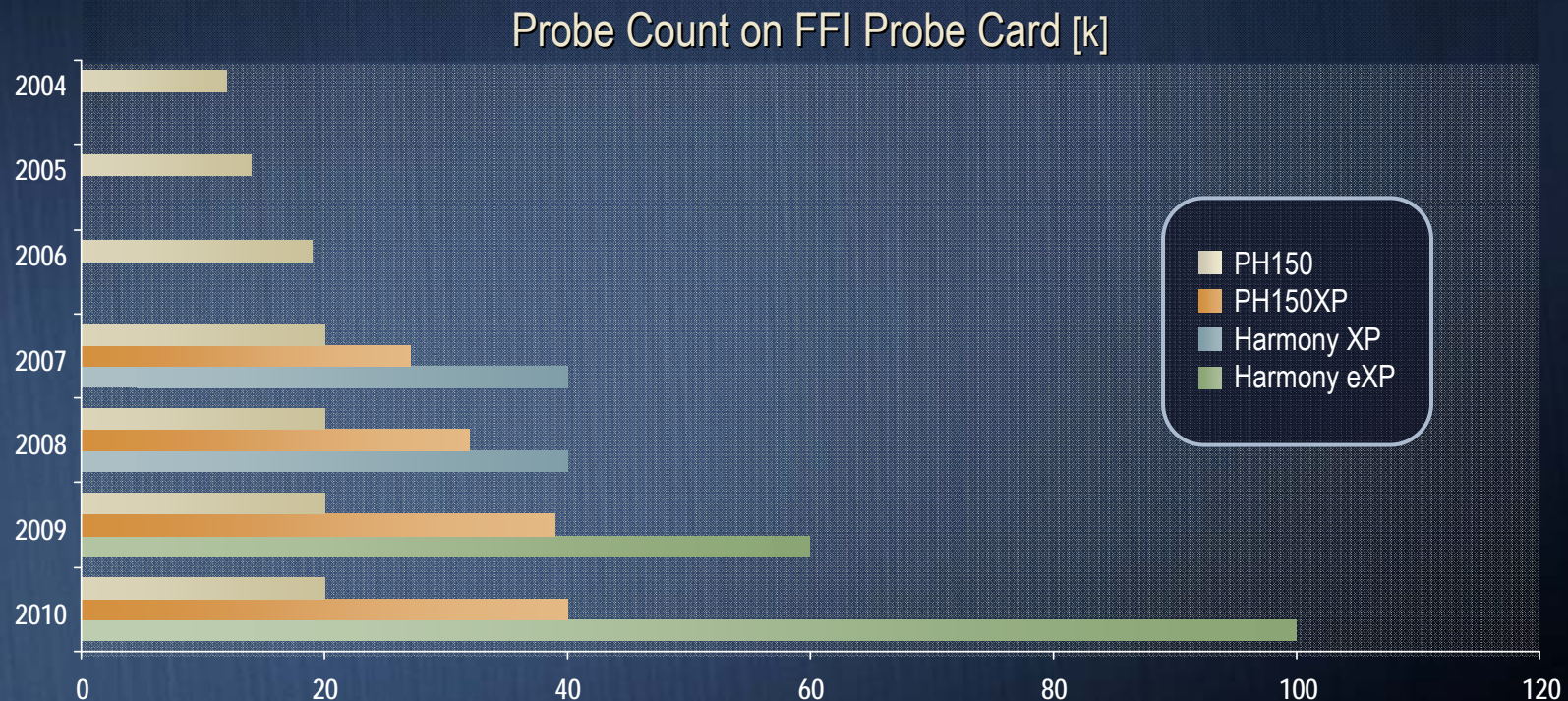
Cameron Harker
Jeff Lin, Stuart Pearce
FormFactor

Outline

- DRAM Probing Trends
- Probe Card Thermal Stability Challenges
- Experimental Design
- Results
- Conclusions
- Acknowledgements

DRAM Industry Probe Count Trend 2009

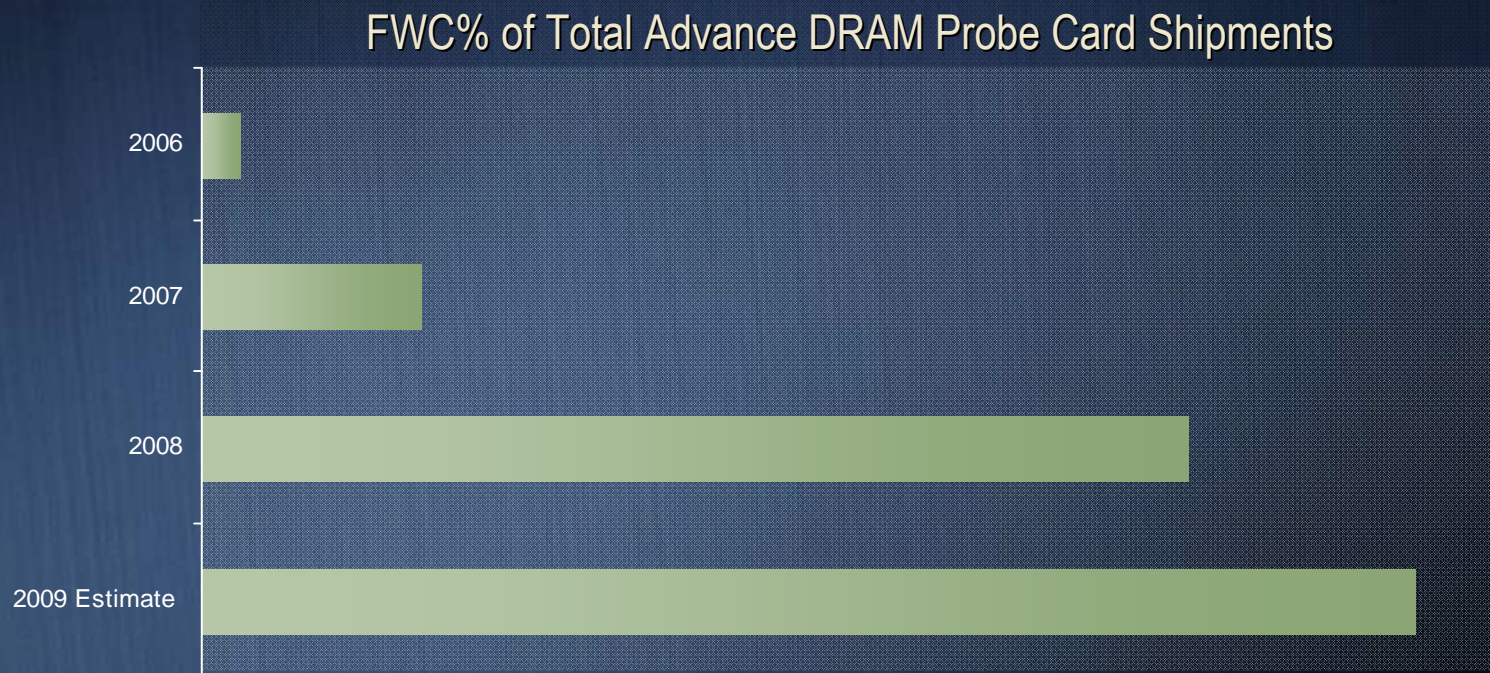
- DRAM cost of test reduction requirements are driving increased probe card parallelism and increased probe counts
 - Achieving 512 DUT parallel testing for DRAM SORT
 - PH150XP and Harmony eXP full wafer contactor
- Overall probe count will continue to increase



Probing Trends

Transition to Full Wafer Contactors

- Transition to full wafer contactors (FWC) driven by need to achieve lowest TD count
 - For some die sizes, FWC enables reduced TD count to accommodate increased parallelism



Data based on FFI's market analysis

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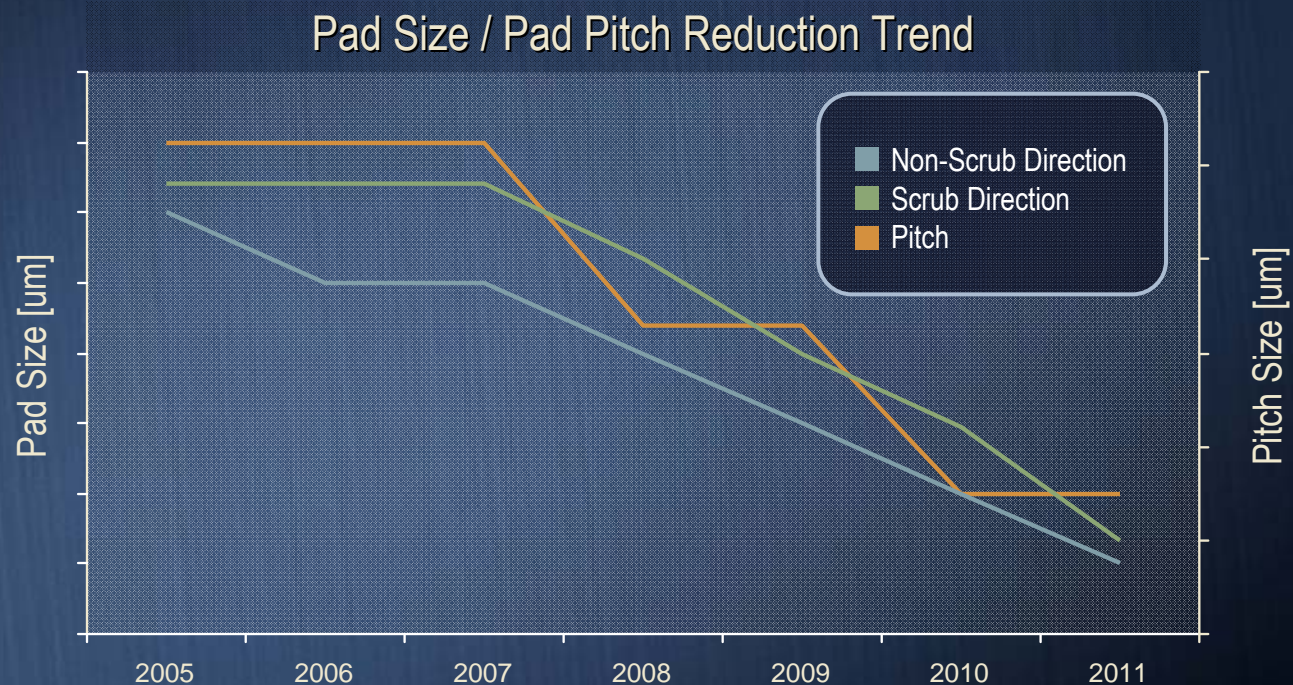


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Probing Trends

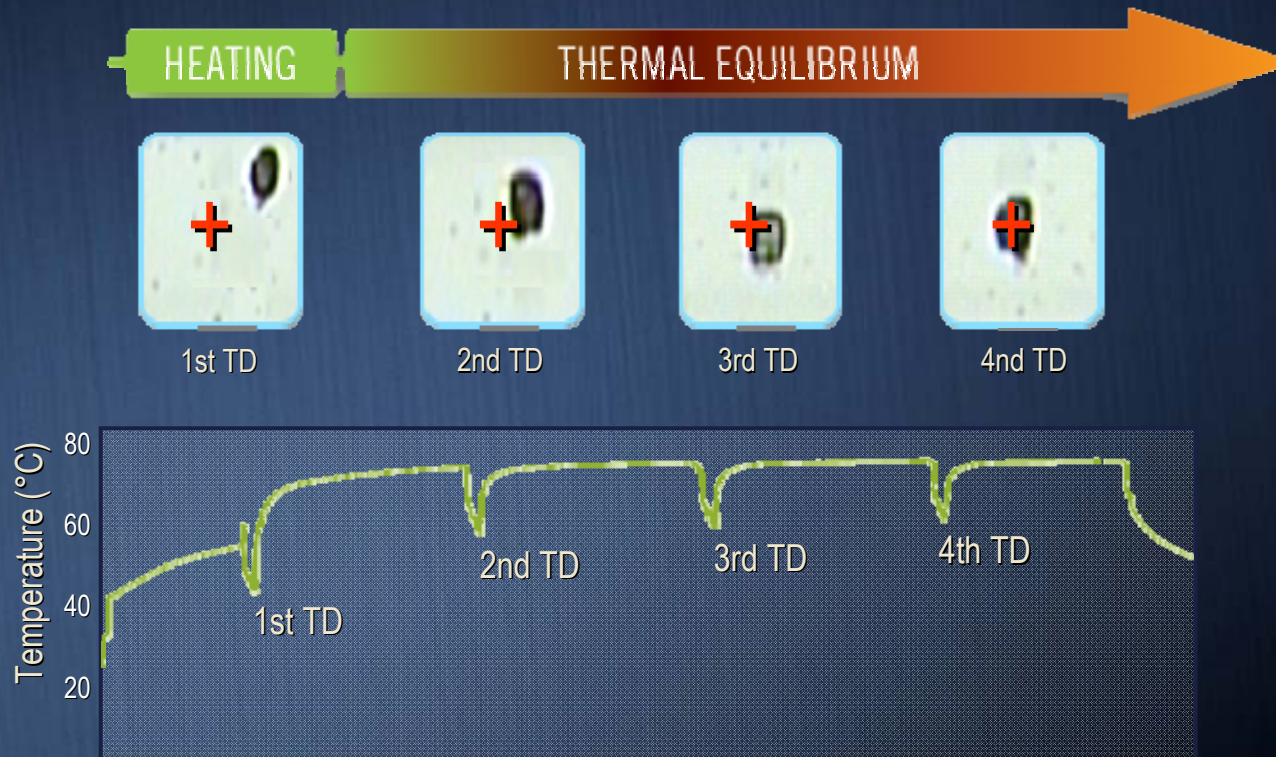
Pad Size / Pad Pitch Reduction

- DRAM pad size/pad pitch reduction – approximately 10%-15% per year going forward
 - Minimum pad size / pad pitch per year
- Overall probing budget is being reduced



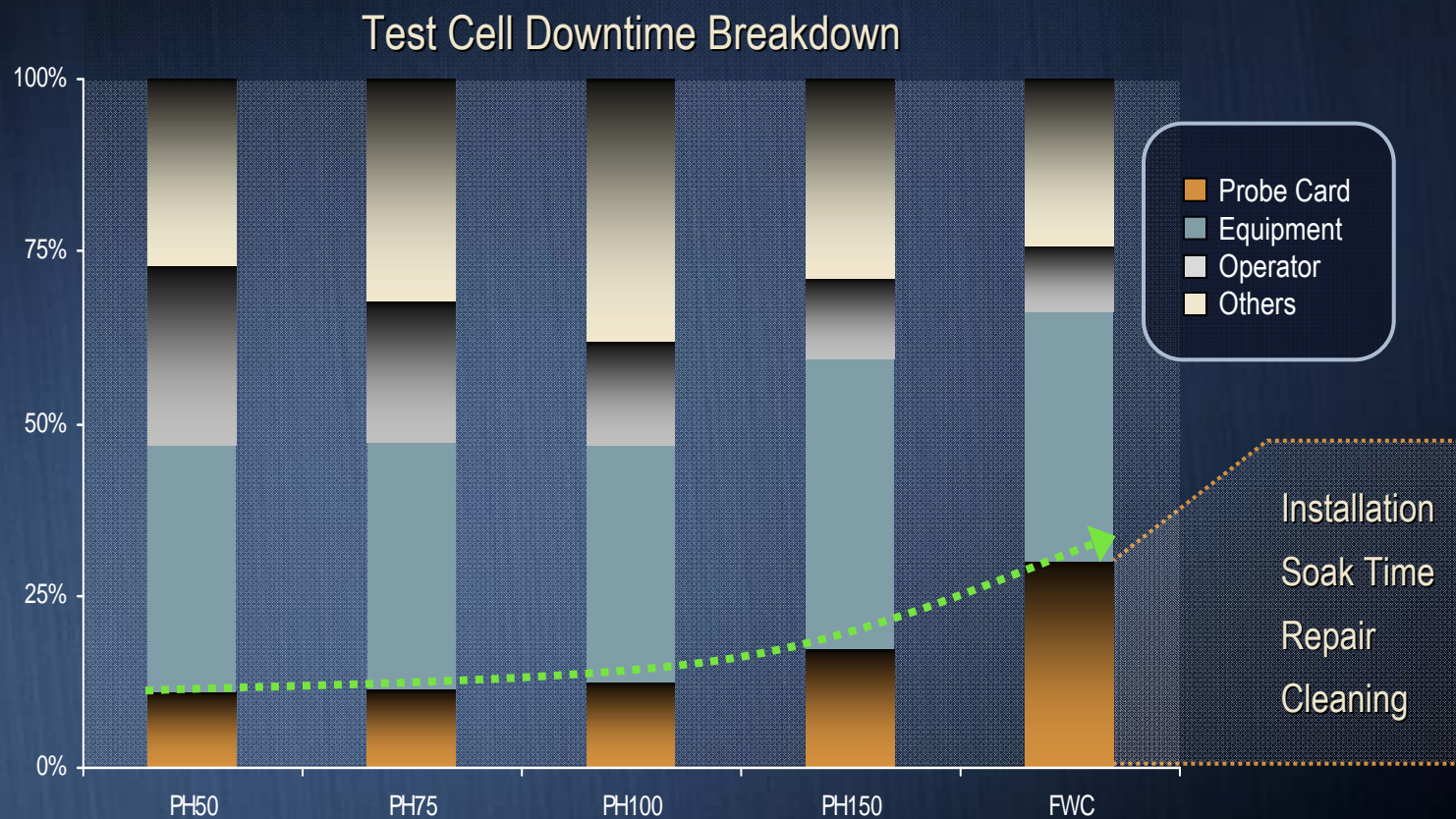
Inconsistent Scrub on Full Wafer Contactor

- Challenge: Inconsistent scrub mark are often observed after lot change, wafer change, probe mark inspection and long idle time
 - Issue occurs regardless of probe card technology
 - With smaller pad sizes, a few microns of change is a real issue



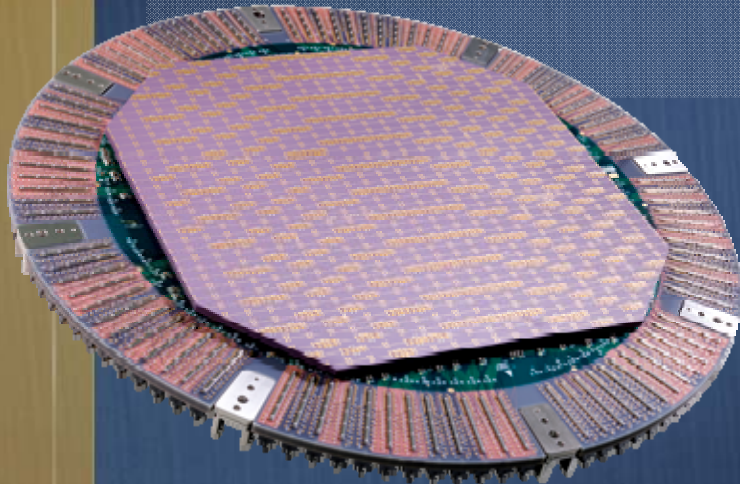
Productivity Reduction by Probe Card Size

Challenge: Minimize test cell downtime with increasing probe card size



Industry Trends / Challenge Summary

Trend / Challenge	Impact to Wafer Probing	Requirement
<p>FWC adoption resulting in larger probe cards</p> <hr/> <p>Increasing probe card design complexity - Higher pin counts / higher parallelism</p> <hr/> <p>Negative productivity impact with increased probe card size</p>	<p>Increased probe card mass resulting in longer soak time and additional soak insertions</p>	<p>Minimize time to reach thermal stability due to increased complexity of probe card and test conditions</p>
<p>Reduced pad size and pad pitch</p>	<p>Decreased probing area / reduced error budgets</p>	<p>Improve scrub accuracy, consistency due to thermal variations</p>



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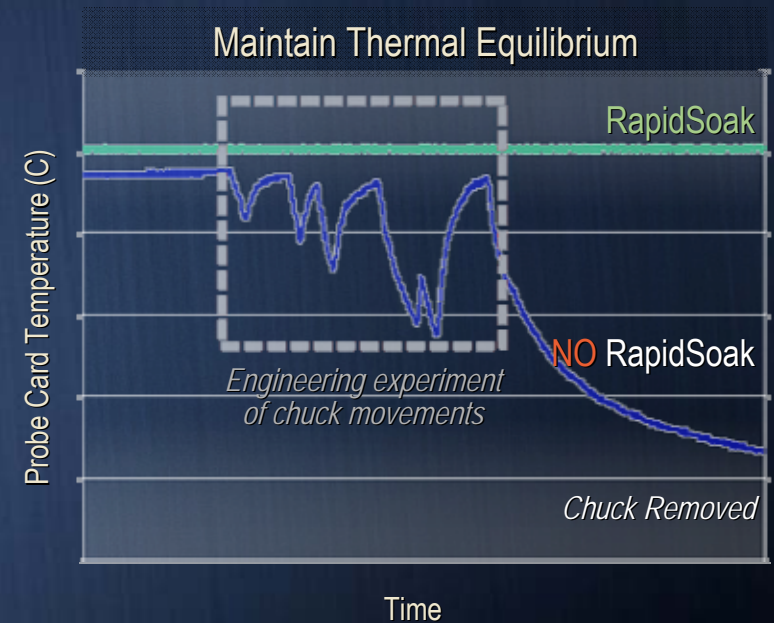
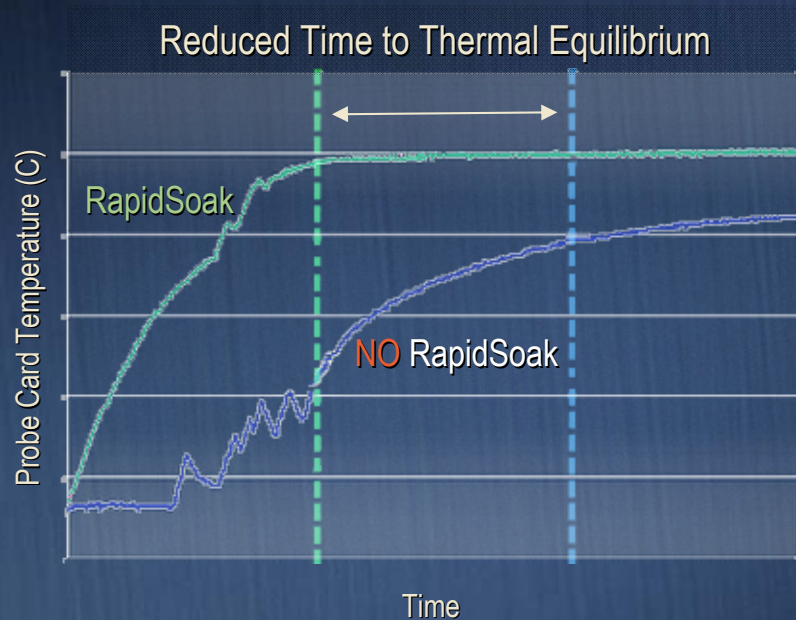
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RapidSoak™ Technology

- FFI's patented RapidSoak technology enables probe cards to reach thermal equilibrium faster and maintain thermal stability
 - Integrated in the probe card for active, real time thermal control



SHORTER SET-UPS

FASTER THERMAL EQUILIBRIUM

HIGHER TEST CELL EFFICIENCY

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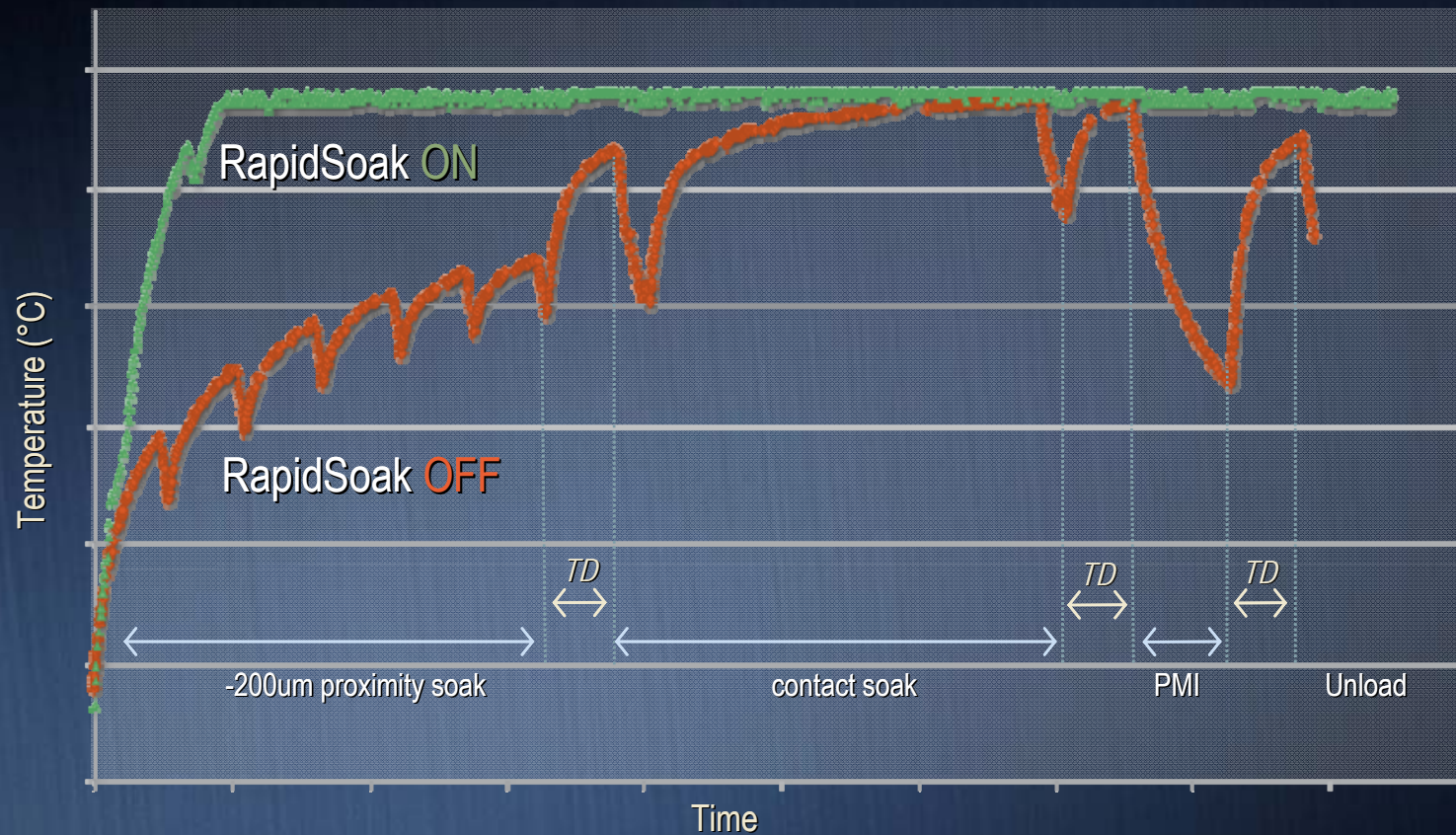
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RapidSoak Characterization Overview

- Characterization Objectives
 - Study RapidSoak's impact on soak time reduction and scrub mark consistency
 - Determine if RapidSoak provides opportunities to improve test cell throughput / efficiency
- Initial data collected using two customer production probe cards
 - Customer A – Harmony eXP, Accretech UF3000EX prober, Advantest T5383 tester
 - Customer B – Harmony eXP, Accretech UF3000EX prober, Advantest T5377 tester
- Data Collection Plan
 - Load probe card in room temperature prober – RapidSoak Off
 - Ramp chuck temperature to desired temperature
 - Load wafer and align probe card
 - Perform proximity soak and TD
 - Perform contact soak and TD
 - Perform PMI and TD
 - Repeat steps a) –f) with RapidSoak On

Thermal Stability Data

Customer "A"

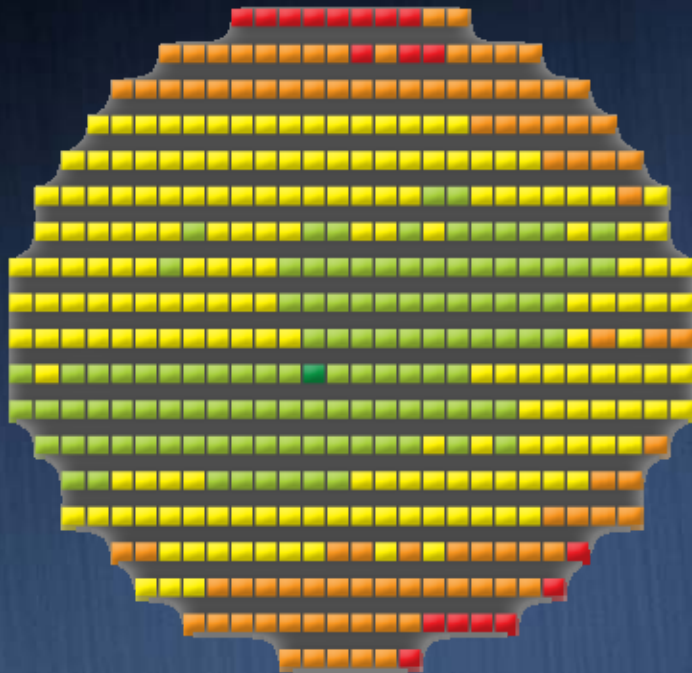


- Thermal stability achieved up to 80% faster with RapidSoak
- Contact soak and additional alignments for thermal instability can be eliminated with RapidSoak on

Scrub Mark Consistency Data

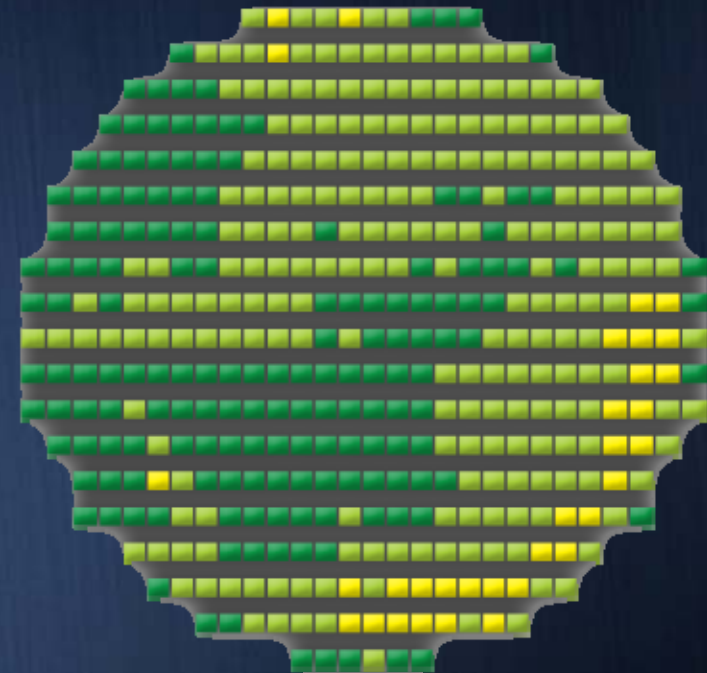
Customer "A"

DUT Ave. Scrub Area | RapidSoak OFF



RapidSoak OFF

DUT Ave. Scrub Area | RapidSoak ON

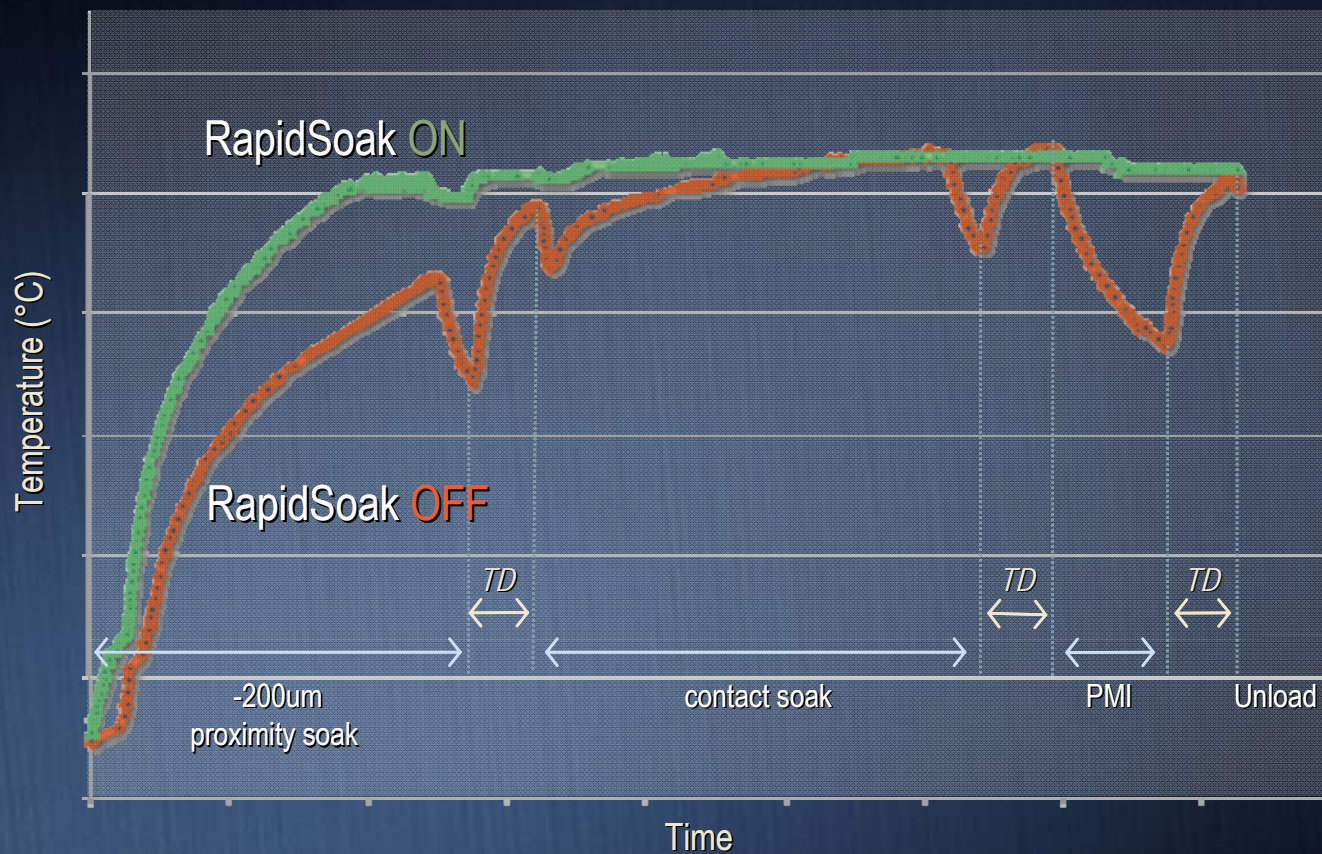


RapidSoak ON

- Average scrub area reduced by 24% with RapidSoak
- Scrub area standard deviation reduced by 37% with RapidSoak

Thermal Stability Data

Customer "B"

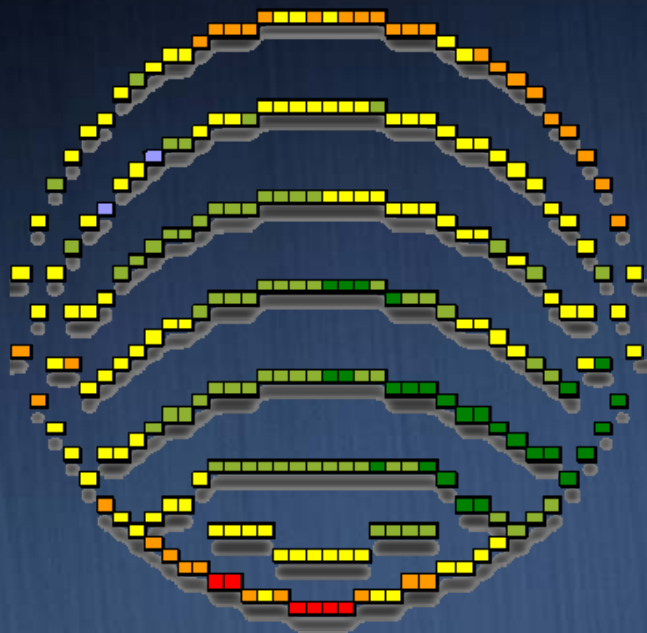


- Thermal stability achieved up to 60% faster with RapidSoak

Scrub Mark Consistency Data

Customer "B"

DUT Ave. Scrub Area | RapidSoak OFF



RapidSoak OFF

DUT Ave. Scrub Area | RapidSoak ON



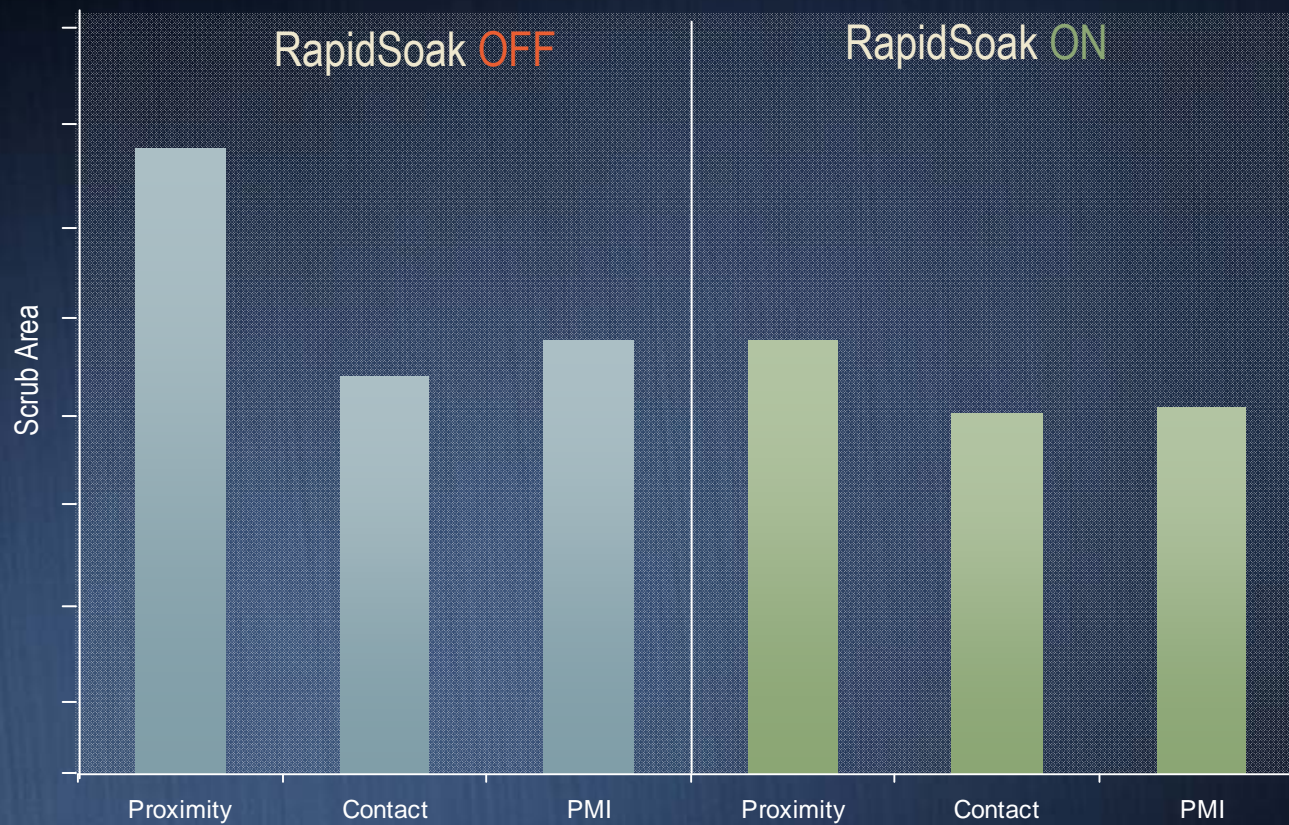
RapidSoak ON



- Average scrub area reduced by 25% with RapidSoak
- Scrub area standard deviation reduced by 26% with RapidSoak

Scrub Mark Consistency Data

Customer "B"



- Three TD wafer composite scrub area reduced by 15% utilizing RapidSoak

Soak Time Reduction Summary Utilizing RapidSoak

Customer	Probe Card Type	Tester Platform	Soak Time Reduction
"A"	FWC	Advantest T5383	80%
"B"	FWC	Advantest T5377	56%
"C"	FWC	Advantest T5377	54%
"D"	FWC	Advantest T5383	67%
"E"	PH150	Advantest T5377	55%
"F"	FWC	Advantest T5377S	0 soak time achieved

- Soak time reductions achieved in each customer qualification utilizing RapidSoak technology
- RapidSoak currently running in production at multiple customers

Summary and Conclusions

■ Summary:

- Probe card designs are increasing in complexity and size
- Overall probing budgets are being reduced with shrinking pad size and pad pitch
- Probe card thermal instability from TD to TD, wafer to wafer results in loss of scrub margin and scrub consistency
- Negative impact to productivity with increased probe card size
- On probe card thermal management needed to enable current probe card trends

■ Conclusions:

- Demonstrated RapidSoak enables soak time reduction
 - Contact soak can be eliminated, proximity soak can be reduced
 - Additional soak after PMI not required
 - Enables faster set-up time and production flow efficiencies
- Probe card thermal equilibrium is maintained with RapidSoak during production operations
 - Enables improved scrub margin and consistency from TD to TD, wafer to wafer
- RapidSoak being used in wafer test production at multiple customers

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Thank You

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